DOCUMENT RESUME

ED 303 782 CS 009 522

AUTHOR	Read, Charles
TITLE	Phonological Awareness and Adult Readers. Final Report.
INSTITUTION	Wisconsin Center for Education Research, Madison.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE	Aug 88
GRANT	G008710016
NOTE	18p.
PUB TYPE	Viewpoints (120) -- Reports - General (140) -- Information Analyses (070)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Adult Basic Education; Beginning Reading; Decoding (Reading); Elementary Education; Phonemes; *Phonics; Reading Instruction; *Reading Skills; *Spelling
IDENTIFIERS	*Phonological Awareness; Segmentals (Phonology); Segmentation Skills

ABSTRACT

Large differences exist among individuals in their ability to process speech sounds within syllables and words, and this ability is crucial for reading and spelling alphabetically beyond a very elementary level. The conception that speech is made up of segments (phonemes) is natural to those who read and spell alphabetically, but arguably: (1) this conception is not phonetically true; (2) it does not develop spontaneously; (3) it is necessary for reading and spelling beyond an elementary level; and (4) it is part of the difficulty that some people (even some adults) have with reading and spelling. Studies of adult poor readers indicate that segmentation is important for them as well as for children. Segmental conception of speech must be taught at an early age with particular attention to those with learning difficulties, but there is no contradiction in recognizing that segmental analysis and phonics skills are critical while also recognizing that learning to read and spell proceeds in several channels at once. (Six figures are included; 34 references are attached.) (RS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
R. Rossmillee

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Phonological Awareness and Adult Readers

Charles Read

Departments of English and Linguistics

A Final Report to
United States Department of Education
Office of Educational Research and Improvement

Grant No. G008710016
1987-88

Wisconsin Center for Education Research
School of Education
University of Wisconsin-Madison

August 1988

Contents

Introduction	Page
Segmentation is not phonetically accurate	1
Segmentation does not develop spontaneously	3
Segmentation is crucial for learning to read and spell (alphabetically)	5
Studies of adults	7
Segmentation is important for adult poor readers also	7
Why are there large differences in phonological awareness? . . .	9
Conclusions	9
Phonics skills	10
What this is not	10
References	12

List of Figures

Figure		Page
1	Waveform and spectrogram	2
2	Waveform and spectrogram with segmenting added	2
3	Chinese character for "horse"	3
4	Chinese character for "mother"	3
5	Manipulating segments (nonwords only) Results of segmentation study in China	4
6	Segmenting vs. reading and spelling Correlations between segmentation and reading/ spelling	8

The most basic and most crucial part of phonological awareness is the conception that speech is made up of segments--that words and syllables can be divided into speech sounds, or "phonemes." This conception underlies alphabetic spelling, which represents these units. To those of us who read and spell alphabetically, this conception seems so natural that it is almost unnoticed, but on the contrary, I will argue that:

- this conception is not phonetically true;
- it does not develop spontaneously;
- it is necessary for reading and spelling beyond an elementary level;
- it is part of the difficulty that some people--even some adults--have with reading and spelling.

Segmentation is not phonetically accurate. The physical stream of speech is not divided into segments; in fact, speech is rapid and continuous changes in air pressure. There are silences and abrupt changes, but not all speech sounds are marked by such changes. Figure 1 represents the physical reality of speech, specifically the first second of "The dog is on (the porch)," as uttered by me on one occasion. The upper half of Figure 1 is a record of the changes in air pressure; as that line moves up, a listener's ear drum moves inward, and as it moves down, the ear drum moves outward. The lower half represents the changing frequencies of sound that make up this utterance; it is helpful in deciding where segments begin and end. Between the two halves of Figure 1 I have written the utterance in ordinary spelling, with each spelling (th, e, etc.) centered under the corresponding sound. Note first that the segments are quite varied in length: for example, the vowel of "dog" is considerably longer than the three sounds which precede it. The sounds also vary in loudness, indicated by the height of the line in the top half: each of the vowels is louder than any of the consonants, and the vowel of "dog" is the loudest.

However, the segmental conception of speech (and alphabetic spelling) treats each "sound" as one unit, ignoring the large differences in duration and loudness. We use more than one letter to spell some sounds, such as th for the consonant in the, but these are not necessarily the longest or loudest ones; in fact, the sound spelled th is one of the shortest and quietest. This is one way in which the segmental view of speech is an abstraction.

Another way is that the "segments" of speech actually overlap, as pointed out by Isabelle Liberman (1970). The two solid vertical lines on Figure 2 enclose the vowel of "dog," while the four dashed lines enclose the d and g. These overlap; that is, the beginning and end of the vowel also carry information about the consonants at the same time. This overlap is partly responsible for the awkwardness of explaining that "d spells 'duh.'" Actually, d spells a sound that cannot be pronounced by itself. Yet the segmental conception and alphabetic spelling treat each speech sound as discrete.

From these facts about speech, we infer that it may be difficult to conceive of segments at first. One objection to this inference is that surely a child who can speak and understand can identify segments; if a child can

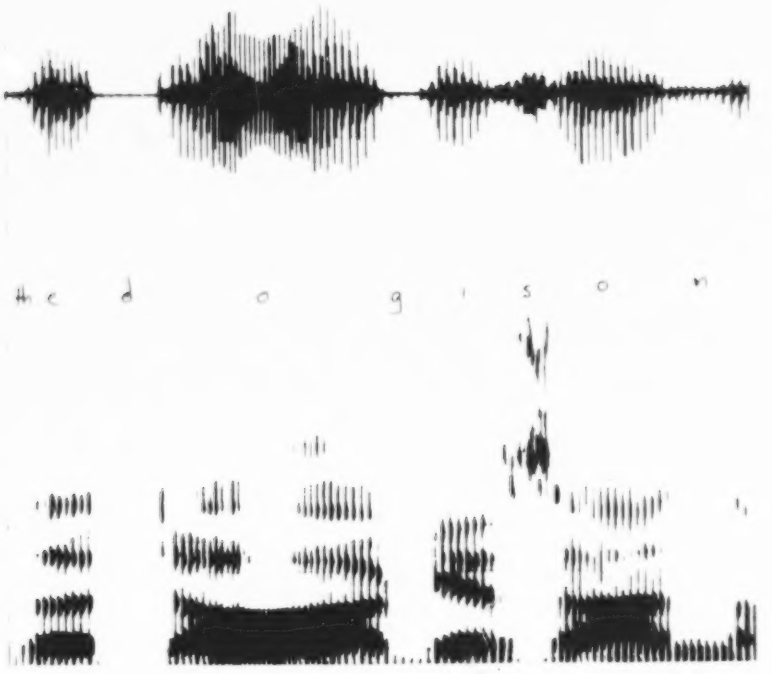

Figure 1. Waveform and spectrogram.

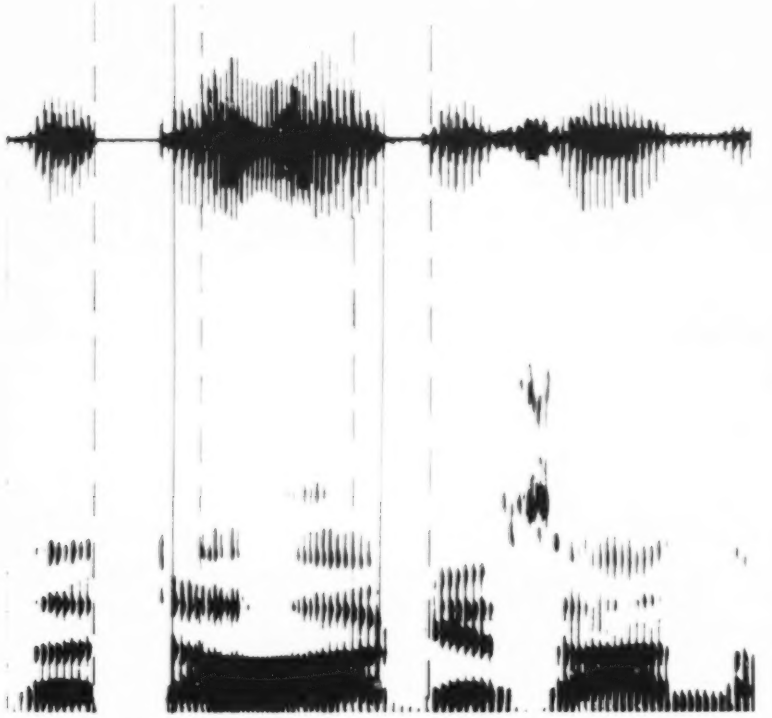

Figure 2. Waveform and spectrogram with segmenting added.

distinguish "dog" from "log," as any normal kindergartener can, is he not therein distinguishing /d/ from /l/? The answer is that distinguishing speech sounds tacitly in comprehension is not at all the same as identifying them more explicitly and lining them up with spellings. Children's reading and, even more clearly, their earliest spellings reveal that they find it difficult to identify speech sounds, especially in certain positions, such as consonants within clusters. The fact that a child can hear the difference between "sand" and "stand" perfectly does not imply that he can 'hear' that "stand" has one more sound or that it occurs in the second position.

Other papers in this volume, such as Prof. Tunmer's, note that learning to identify, count, and manipulate sound segments is difficult; one possible reason is that these "segments" are unequal, overlapping, and variable in actual speech, but represented as equal, discrete, and invariant in spelling. I am not suggesting that the segmental conception of speech is unnatural or unreal. On the contrary, once acquired, it has seemed quite natural to most alphabetic readers since the Phoenicians. However, it is an abstract conception; it must be achieved (by learning what counts as a unit in spelling), rather than merely apprehended from the physical signal. In that sense, it requires imagination on the part of the learner. We as teachers need another kind of imagination, namely, to imagine what it is like not to think that "dog" is made up of three sounds. To some learners, this conception is not obvious, and the speech signal does not make it obvious.

Segmentation does not develop spontaneously. If segments are not made evident in speech, does this conception develop by itself or only in the process of learning to read and spell alphabetically? Illiterates usually lack this conception, it seems (Morais, Cary, Alegria, & Bertelson, 1979). We tested this issue further by comparing two kinds of literates in China: those who could read only Chinese characters and those who could also read alphabetic writing.

In contrast to alphabetic writing, Chinese characters do not directly represent speech sounds. Figure 3 illustrates the simplest sort; it is the character for "horse," pronounced /ma/, with a tone which falls and then rises. This character as a whole represents the word for "horse"; no part of it represents the sound /m/ or /a/. Some characters do have parts that refer to sounds, but to syllables, not segments. For example, Figure 4 is the character for "mother," also pronounced /ma/ but with a level high tone.

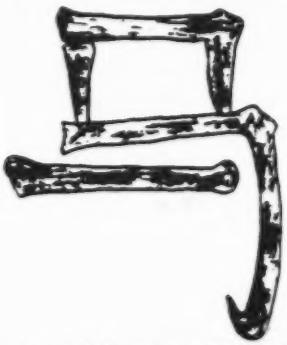

Figure 3. Chinese character for "horse."

Figure 4. Chinese character for "mother."

The left side of the character means "woman," but the right side is the character for "horse" again. Chinese writing is not implying a connection between mothers and horses (!); rather, the "horse" part of the character alludes to the similarity in sound. A reader who did not know the character for "mother" might decipher it this way: 'means something to do with "woman"; sounds something like "horse."' To a speaker of Chinese, this suggests /ma/ ("mother"). However, even in the phonetic part of the character for "mother" there is nothing that represents the sounds /m/ or /a/. Reading Chinese can be a sophisticated word game, but not one that requires a segmental conception of speech, apparently.

This fact brings us back to the developmental question: Do speakers of Chinese think of speech as segmental, or does this conception go along with alphabetic writing? In other words, does everyday use of language, other than alphabetic writing, require us to think of speech as segmental? In China today, there are people who read only characters and people who also once learned to read alphabetically, because an alphabetic writing system for Chinese was introduced into primary schools after 1950. (The alphabetic system is not widely used outside of schools, however.) We compared alphabetic and nonalphabetic readers, using a spoken task that requires a segmental conception of speech, namely adding or taking away a consonant at the beginning of a spoken word. Thus, given /an/, add /s/ to make /san/ or given /san/, take away /s/ to make /an/. The task is relatively difficult, but we gave our subjects a great deal of demonstration and correction. Figure 5 displays the results.

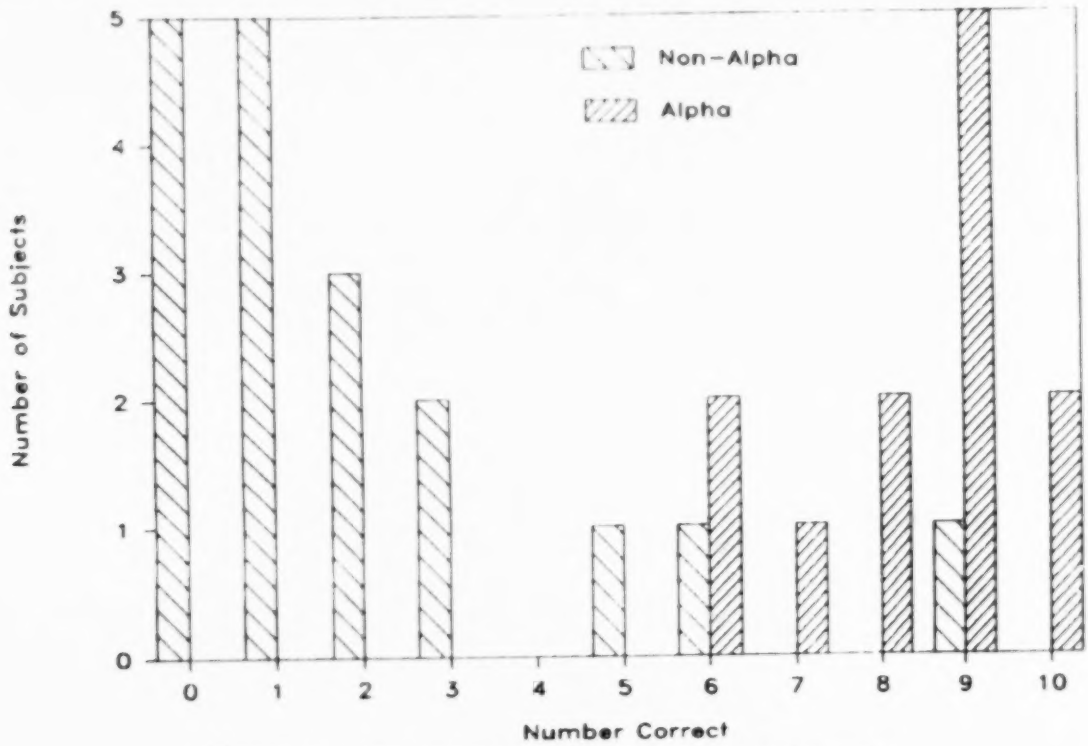

Figure 5. Manipulating segments (nonwords only)
Results of segmentation study in China

The two kinds of vertical bars in Figure Five represent people who had once learned to read alphabetically ("Alpha") and people who could read only Chinese characters ("Non-Alpha"). The height of each bar indicates the number of people; the horizontal axis is the number of items correct out of the last ten. There is almost no overlap between the two groups: non-alphabetic readers got most items wrong, and alphabetic readers got most items right. Even the major exception, the non-alphabetic reader who got nine items right, seems to fit this rule; she admitted to us later that she had learned "a little" about alphabetic writing when her son was in school.

All of these subjects could read characters, and they all had similar levels of education. They were cooks, waitresses, tailors, barbers--ordinary citizens. In fact, many of the alphabetic readers could now read alphabetic writing only slowly and with great difficulty, but they found our segmentation task vastly easier than the non-alphabetic readers did. The key difference seems to be that they had once learned to conceive of speech as segmental.

Spoken Chinese contains many other clues to the segmentation of speech. Because of its syllable structure, there are many rhyming and alliterating words; in fact, rhyme is important in Chinese verse. As in any other language, there are puns, jokes, and slips of the tongue that exchange one sound between two words. Evidently, these implicit demonstrations do not lead most people to think of speech as made up of speech sounds, but learning to read and spell alphabetically does, even if that training took place years ago and the skill is no longer fluent.

In other words, a segmental conception of speech does not develop spontaneously but is usually associated with learning to read alphabetically. It also may develop gradually, not as an epiphany. Some consonants are inherently more distinct from vowels than others; for example, the /z/ in zip can be pronounced by itself; the /d/ in dip cannot. With experience in reading and spelling as well as in rhyming and other sound judgments, segments may slowly become more accessible to awareness and to manipulation. Likewise, skills that depend on that awareness may develop gradually.

Segmentation is crucial for learning to read and spell (alphabetically). Speech is not physically divided into segments, and the idea that it can be segmented does not develop automatically--those two conclusions support each other. However, they would be of no educational importance were it not for another finding, namely that this conception is important, even crucial, for learning to read and spell. Some of the contributors to this volume have done the major research; see the chapters by Bryant, Byrne, Lundberg, and Tunmer.

An evaluative comment may be in order, however. Professor Bryant makes a strong claim: that segmentation skill, embodied in rhyming and other judgments of sounds, is not merely helpful but necessary for learning to read and spell. Professor Tunmer points out that in Bradley and Bryant's studies (1983), training in sound categorization by itself made a difference, but not a significant one--apparently because it did not help some children. This fact is not paradoxical if one assumes that there are other necessary conditions, that segmentation skill is necessary but not sufficient for learning to read, which is what Tunmer is suggesting.

The relatively small effect of training in sound judgments alone really means three things. First, the effect of that training may not be reliable; it may not occur in other studies. Bradley's retesting of these children years later tends to disconfirm this possibility. Second, sound training is no "magic pill" for difficulty in learning to read; it does not help all children. Reading teachers and researchers have stopped believing in single treatments anyway. Third, sound training had a greater effect when combined with training on basic relationships between sounds and spellings. For teaching reading and spelling, this is not a disadvantage.

We must also bear in mind the extraordinary standards of proof which Bradley and Bryant have met: they have shown both a predictive relationship and an effect of training, over periods of years with powerful factors like IQ, verbal ability, memory, and age controlled. Now they report that the effects of about seven hours of training can be discerned even four years later, with children who have been receiving other reading training in the meantime. Very little educational research comes close to meeting those standards; few studies control for such powerful variables, and fewer still look for effects after four years. With those controls, even relatively modest effects may be of great practical importance. Most reading teachers would gladly trade several hours of instruction for the likelihood of four months' gain in reading ability among children expected to have difficulty in learning to read.

Other researchers have also combined correlational with experimental methods in testing the value of segmentation training. Torneus (1984) did so in Sweden, with results that parallel Bradley and Bryant's. From a year-long study of 46 dyslexics and 44 children with normal reading and spelling in grades one and two, she concluded that both spelling and reading are affected by segmental ("metaphonological") skills and that reading is also determined by general cognitive development. In the United States, Fox and Routh (1984) followed up an earlier correlational study with a training study in which children trained in both segmenting and blending (of initial and final consonants) performed a reading task significantly better than those who received no training or those trained in segmenting only. As in Bradley and Bryant, a combination of training was most effective, and the total amount of training was only about seven hours.

The theme of this volume is the roles of metalinguistic abilities in learning to read and spell; why emphasize segmentation in particular? One answer comes from longitudinal research by James and Blachman (1987). They compared four kinds of metalinguistic knowledge (segmentation, syntax, word reference, and ambiguity-detection) as predictors of reading achievement (word identification, word attack, and paragraph comprehension) through grades one to three. All four types of metalinguistic knowledge predicted reading achievement (depending on grade level and reading measure), but the most consistent predictor was segmentation, which strongly predicted all three reading measures at all three grades.

No comparable studies have examined the importance of a segmental conception for learning to spell, although perhaps it is evident that we draw upon segmentation skills in spelling. Even skilled adult spellers often divide an unfamiliar word into segments, at least partially, in order to spell it. The emergence of a segmental conception becomes apparent in young children's

"invented spelling" (Read, 1986). It might seem that a child who can devise her own spellings must have rather well-developed segmentation skills--how else could she spell? In fact, however, segmentation emerges gradually in spelling. Early spellings often represent only initial consonants, such as F for "find." Alternatively, they may use a letter to represent its letter-name, as in RU for "are you," thus representing syllables rather than segments. Later invented spellings do represent segments, often with fine phonetic discrimination, but even in advanced invented spellings, segments are not necessarily the same as in standard spelling. A frequent instance is that words like "bent" are spelled BET or BAT; that is, nasals before a consonant are omitted. (The same spellers typically represent nasals before vowels.) There are good phonetic reasons for this pattern, among which is the fact that preconsonantal nasals coalesce with the preceding vowel into a nasalized vowel. Phonetically, "bent" may really have three segments, not four. Thus, segmentation continues to develop during invented spelling, even over a period of years. Segmentation is not a prerequisite for spelling, at least not children's invented spelling. Rather, invented spelling is a process within which a child develops and refines a segmental view of speech; that is one of its values.

Studies of adults. We have recently studied adequate and poor adult readers. Unlike the numerous studies of children and of college readers, our subjects are men in United States prisons, where low literacy is common. Our average subject is a 30-year-old high school dropout. The adequate readers comprehend at a high school level, as expected; the poor readers comprehend at a fourth-grade level. We have been asking, What skills in language, memory, and cognition distinguish the poor from the adequate readers? Research with prisoners is necessarily messy; reading problems are confounded with other cognitive, personal, and social pathology, but in studying these men we have learned about adult reading difficulties in an important part of society.

Segmentation is important for adult poor readers also. We gave eleven tests of the ability to identify and manipulate sounds within syllables, including judging and producing rhymes, repeating initial and final consonants, producing alliteration, judging whether a certain sound occurs within a word and where it occurs, counting sounds and syllables, and adding a consonant to the beginning of a syllable. All of these tasks have been used as measures of "phonological awareness." Total score on these tasks is highly correlated with the ability to read and spell individual words. Figure 6 shows these correlations for three types of words: regular spellings (<u>home</u>, <u>dome</u>), exceptional spellings (<u>some</u>, <u>come</u>), and novel words (<u>lome</u>, <u>jome</u>).

As expected, the correlations are highest for the novel words, which must be read or spelled by using sound/spelling relationships, and lowest for the exceptional words, which cannot be read or spelled that way. For spelling novel words, segmentation accounts for half of the variability among subjects ($r = .71$ = 50% of variance). In reading and spelling, our adults who read at a fourth-grade level perform like poor readers in fourth and fifth grade (Read & Ruyter, 1985, with comparisons to Treiman, 1984, and Richardson, DiBenedetto, & Adler, 1982). The nature of poor reading does not appear to change with age and cognitive maturation.

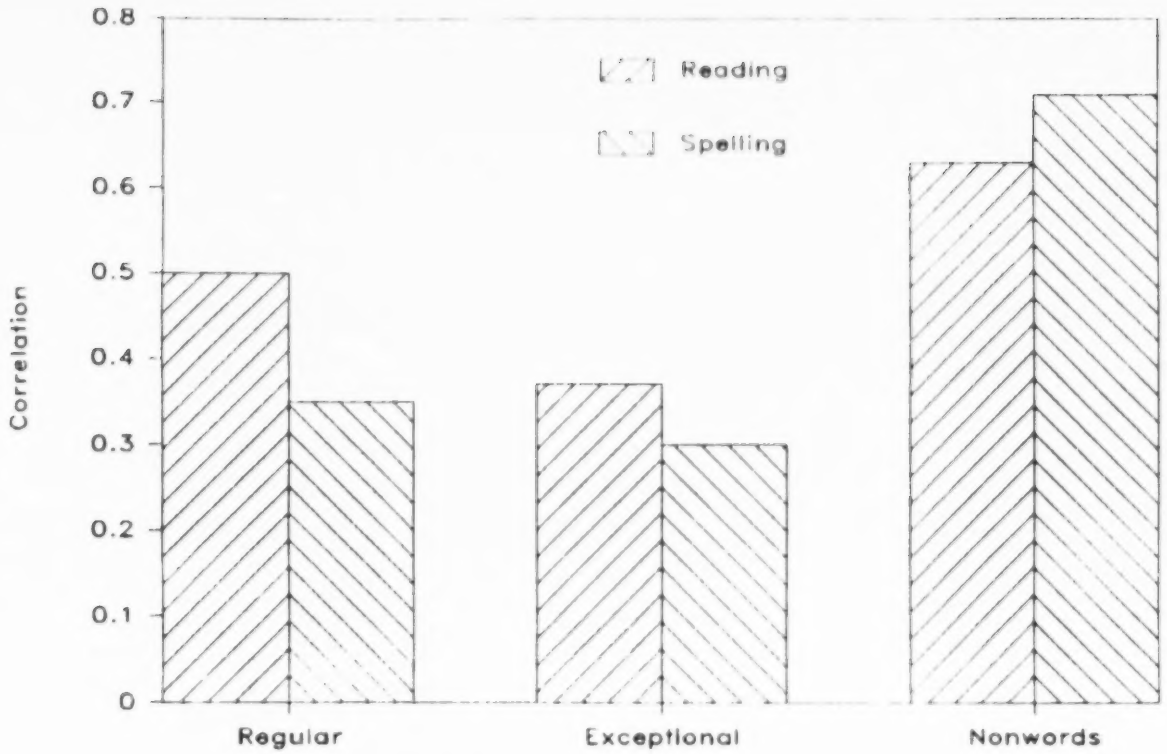

Figure 6. Segmenting vs. reading and spelling
Correlations between segmentation and reading/spelling

Statistically, the eleven phonological awareness tasks divide into two types: type one consists mainly of rhyming tasks, while type two consists of tasks specific to one location within a word: repeating or adding an initial or final consonant, or saying where a sound occurs within a word. (Stanovich, Cunningham, and Cramer, 1984, also found that such tasks formed a single factor.) Type one was significantly correlated with reading and spelling all types of words, while type two was associated only with reading and spelling novel words, for which sound/spelling relationships are essential. We think these two types of tasks measure two levels of phonological awareness. When we ask a reader to focus on one location within a word, we are tapping a level of phonological awareness that is crucial for reading and spelling new words. One characteristic of our adult poor readers, contrasted with adequate readers from the same backgrounds, is that they have small reading (and listening) vocabularies. We suspect that their vocabularies grow very slowly because they cannot read or spell words that they have not already learned as wholes.

Why are there large differences in phonological awareness? All of this research suggests that becoming aware of segments within syllables is crucial for learning to read and spell alphabetically. Of course, many other abilities are necessary for reading, such as the ability to discern similarities and differences in letter shapes or to control eye movements. In fact, visual skills are more <u>obviously</u> necessary than phonological awareness, but they do not account for much of the difference between good and disabled readers (Just & Carpenter, 1987, 383-385; Jorm, 1983, 42-43; Vellutino, 1979).

There are several competing theories about why segmental structure is obvious to one person but murky to another of equal general intelligence. Part of the answer may be, as I suggested above, that the alphabet is an abstraction: segments do not exist as discrete and invariant units in speech. Also, poor segmenters tend to have poor short-term memory (STM) (Liberman, Shankweiler, Liberman, Fowler, & Fischer, 1977; Mann, Liberman, & Shankweiler, 1980; Katz, Shankweiler, & Liberman, 1981). Short-term memory is necessary for decoding (building up a mental representation of the sound of a word from the sequence of spellings) and for encoding (holding such a representation in memory while relating it to spellings). For our adult poor readers in prison, STM is the best predictor of decoding skill, and decoding skill is the best predictor of reading comprehension. These relationships are not true of the adequate readers; above a certain threshold in STM and decoding, other factors become more important. On average, our poor readers are one standard deviation below the mean STM score for adults in general. In our sample, there are few poor readers who are normal in STM and few adequate readers who are not. Jorm and Share (1983) argue that the relationship is the other way around: that a phonological representation of language is necessary for short-term memory.

Another theory is that poor segmenters have a subtle disability in perceiving speech; their problems may not be limited to print. According to this theory, we do not observe their disability under normal listening conditions, because speech is highly redundant, so speech perception is usually excellent. Brady, Shankweiler, and Mann (1983) showed that poor readers in third grade were indeed poorer than good readers at perceiving spoken words when listening was made difficult by noise. We found the same difference among adults, but only for words familiar to our poor readers. This difference is small, however; it may be an effect of the reading and STM deficits, rather than a cause.

A third hypothesis is that poor segmenters have difficulty in perceiving <u>any</u> rapidly changing stimulus--not only speech but even tones and pictures (Tallal, 1980). This view seems to include the second one but may also conflict with it, because Brady, Shankweiler, and Mann (1983) and our study of adults showed that the perception problem was limited to <u>speech</u>; there were no differences in perceiving other sounds, such as ringing, knocking, clicking, and banging. Speech certainly qualifies as rapidly changing; Figure 1 displays <u>one second</u> of speech, with nine segments. The other sounds compared with speech in the perception studies stay the same for a longer time or are repetitive.

Conclusions. Whatever the reasons, there are large differences among people in their ability to access speech sounds within syllables and words, and this ability is crucial for reading and spelling alphabetically beyond a very

elementary level. What does that mean for teaching? To me it suggests that we must foster the segmental conception of speech at an early stage, with particular attention to children who have difficulty. How? Bradley and Bryant used rhyming, alliteration, and "odd one out" judgments (Which word doesn't fit: weed, need, peel, deed?), followed by demonstrations of how spelling reflects these similarities and differences. These games were effective and evidently fun. Fox and Routh used "segmenting" and "blending": identifying the initial and final consonants of monosyllables and combining initial consonants with rimes, such as "mmm--an." There are probably as many games and exercises as there are teachers, but we know that these, at least, work.

Phonics skills. In suggesting sound judgment games followed by bridges to spelling, I am of course urging the teaching of phonics in some of its forms. This recommendation is currently unpopular; the emphasis in reading programs is on predicting meaning from higher-level information in a text, including syntactic, semantic, and pragmatic context. Skilled readers do use context to integrate meaning better than poor readers, but it does not follow that decoding is unimportant. On the contrary, study after study has found that segmental awareness and decoding skill are crucial differences between good and poor readers. Stanovich (1982a) reviewed that evidence; see also Treiman and Baron (1981). Stanovich, Cunningham, and Feeman (1984) found that decoding speed helps to predict reading comprehension at grades one, three, and five, even beyond the effects of IQ, listening comprehension, and phonological awareness (!). That study found "three relatively independent abilities [that predict] early reading progress": verbal comprehension, phonological awareness, and decoding speed (p. 295). In fact, poor readers actually rely more heavily on context for word identification because of their poor decoding skills--but only when they can understand the context despite their decoding difficulties (Stanovich, 1982b, 1984). Perhaps most important, fluent adult readers still use decoding skills in reading ordinary sentences (Treiman, Freyd, & Baron, 1983).

Every serious theory of reading includes both word-level and contextual processes, but decoding skills are critical for beginning readers, readers confronting difficult texts, and disabled readers (Jorm, 1983, ch. 3; Jorm & Share, 1983; Just & Carpenter, 1987, pp. 93-100, 338-344; Stanovich, 1982a, 1984). Reading instruction has a special obligation to poor readers, and to children who are at risk of becoming poor readers. If anything, segmental awareness is even more important for spelling (Perin, 1983; Treiman, 1984). Despite the notorious unpredictability of English spelling, sound/spelling relationships are still at the center of the system, whereas context is useful only for distinguishing between homophones.

What this is not. I am not suggesting that we postpone other reading experiences until a child passes some threshold in sound/spelling skills, that we drill children on sound similarities and their spelling without showing that reading can be fun. Like most complex activities, reading and spelling can and should be approached in several ways at once. Having good stories read to you, recognizing words and phrases as units in environmental print, making up one's own spellings, playing at reading--these are all part of initial reading and spelling, and they have motivational and developmental value whether or not they foster segmental awareness. There is no contradiction in recognizing that

segmental analysis and phonics skills are critical while also recognizing that learning to read and spell proceeds in several channels at once. Diverse experience in reading and spelling is essential, the skillful reader operates on every level of language, and given the opportunity, a child may find her own motivation and direction in learning to read and spell--one can acknowledge all of these truths while also acknowledging that segmental analysis and decoding skills are crucial. In fact, it is dangerous to suggest otherwise.

References

Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read--a causal connection. Nature, 301 (5899), 419-421.

Brady, S., Shankweiler, D., & Mann, V. A. (1983). Speech perception and memory coding in relation to reading ability. Journal of Experimental Child Psychology, 35, 345-367.

Fox, B., & Routh, D. K. (1984). Phonemic analysis and synthesis as word attack skills: Revisited. Journal of Educational Psychology, 76, 1059-1064.

James, S. L. & Blachman, B. A. (1987, November). Metalinguistic abilities and reading achievement in first through third grades. Paper presented at the American Speech-Language-Hearing Association, New Orleans

Jorm, A. F. (1983). The psychology of reading and spelling disabilties. London: Routledge & Kegan Paul.

Jorm, A. F., & Share, D. L. (1983). Phonological recoding and reading acquisition. Applied Psycholinguistics, 4, 103-147.

Just, M. A., & Carpenter, P. A. (1987). The psychology of reading and language comprehension. Boston: Allyn and Bacon.

Kamhi, A. G., & Catts, H. W. (1986). Toward an understanding of developmental language and reading disorders. Journal of Speech and Hearing Disorders, 51, 337-347.

Katz, R. B., Shankweiler, D., & Liberman, I. Y. (1981). Memory for item order and phonetic recoding in the beginning reader. Journal of Experimental Child Psychology, 32, 474-484.

Liberman, I. Y. (1970). Basic research in speech and lateralization of language: Some implications for reading disability (Status Report on Speech Research, S-R 24). New Haven, CT: Haskins Laboratories.

Liberman, I. Y., Shankweiler, D., Liberman, A. M., Fowler, C., & Fischer, F. W. (1977). Phonetic segmentation and recoding in the beginning reader. In A. S. Reber & D. L. Scarborough (Eds.), Toward a psychology of reading: The proceedings of the CUNY conferences (pp. 207-225). Hillsdale, NJ: Erlbaum.

Lundberg, I., Olofsson, A., & Wall, S. (1980). Reading and spelling skills in the first school years predicted from phonemic awareness skills in kindergarten. Scandinavian Journal of Psychology, 21, 159-173.

Mann, V. A. (1984). Longitudinal prediction and prevention of early reading difficulty. Annals of Dyslexia, 34, 117-136.

Mann, V. A., & Liberman, I. Y. (1984). Phonological awareness and verbal short-term memory: Can they presage early reading problems? Journal of Learning Disabilities, 17, 592-599.

Mann, V. A., Liberman, I. Y., & Shankweiler, D. (1980). Children's memory for sentences and word strings in relation to reading ability. Memory and Cognition, 8, 329-335.

Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? Cognition, 7, 323-331.

Perin, D. (1983). Phonemic segmentation and spelling. British Journal of Psychology, 74, 129-144.

Read, C. (1986). Children's creative spelling. London: Routledge and Kegan Paul.

Read, C., & Ruyter, L. (1985). Reading and spelling skills in adults of low literacy. Remedial and Special Education, 6 (6), 43-52.

Richardson, E., DiBenedetto, B., & Adler, A. (1982). Use of the decoding skills test to study differences between good and poor readers. In K. D. Gadow & I. Bialer (Eds.), Advances in learning and behavioral disabilities (Vol. 1, pp. 27-74). Greenwich, CT: JAI Press.

Shankweiler, D., Liberman, I. Y., Mark, L. S., Fowler, C. A., & Fischer, F. W. (1979). The speech code and learning to read. Journal of Experimental Psychology: Human Learning and Memory, 5, 531-545.

Stanovich, K. E. (1982a). Individual differences in the cognitive processes of reading: I. Word decoding. Journal of Learning Disabilities, 15, 485-493.

Stanovich, K. E. (1982b). Individual differences in the cognitive processes of reading: II. Text-level processes. Journal of Learning Disabilities, 15, 549-554.

Stanovich, K. E. (1984). The interactive-compensatory model of reading: A confluence of developmental, experimental, and educational psychology. Remedial and Special Education, 5 (3), 11-19.

Stanovich, K. E., Cunningham, A. E., & Cramer, B. B. (1984). Assessing phonological awareness in kindergarten children: Issues of task comparability. Journal of Experimental Child Psychology, 38, 175-190.

Stanovich, K. E., Cunningham, A. E., & Feeman, D. J. (1984). Intelligence, cognitive skills, and early reading progress. Reading Research Quarterly, 19, 278-303.

Tallal, P. (1980). Auditory temporal perception, phonics, and reading disabilities in children. Brain and Language, 9, 182-198.

Torneus, M. (1984). Phonological awareness and reading: a chicken and egg problem? Journal of Educational Psychology, 76, 1346-1358.

Treiman, R. (1984). Individual differences among children in reading and spelling styles. Journal of Experimental Child Psychology, 37, 463-477.

Treiman, R., & Baron, J. (1981). Segmental analysis ability: Development and relation to reading ability. In G. E. MacKinnon & T. G. Waller (Eds.), Reading research: Advances in theory and practice (Vol. 3). New York: Academic Press.

Treiman, R., Freyd, J., & Baron, J. (1983). Phonological recoding and use of spelling-sound rules in reading of sentences. Journal of Verbal Learning and Verbal Behavior, 22, 682-700.

Vellutino, F. R. (1979). Dyslexia: theory and research. Cambridge, MA: MIT Press.